CONTENTS

Date	Revision No.	Page	Summary
Mar 30. 2011	P00	All	LTN121XL01-N01 Product spec was issued first.
Apr 01. 2011	P01	7 10 12 12	- CR was changed to Typ.700 - Vsync Frequency(40Hz) Information was added - LED Driver IC spec was updated (LED Input Current, LED Input Power) - Explanation for LED Driver IC PWM duty ratio was added
Apr 18. 2011	P02	All	Product Code is changed to LTN121XL01-N02
May 11. 2011	P03	23, 24	Product Drawing is updated and added
May 12. 2011	P04	31,32,33	Product EDID is updated
May. 23. 2011	P05	25~28 10	- Packing spec is updated - Main Frequency is changed (96Mhz → 71.29Mhz @ 60Hz, 64.1Mhz → 47.5Mhz @ 40Hz)
Jun. 28. 2011	P06	31~33 5	- 40Hz information in Product EDID - Weight Spec is changed(Typ.210/Max.220 → Typ.200/Max.210)
Jul. 15. 2011	P07	All 27	- Model Code is changed_LTN121XL01-N01 → LTN121XL01-N03 - Product Label is changed to small Label for Tablet Product
Aug. 23. 2011	P08	10 5 7 16 25 21 All 24 7 30~32 29	- Current of Power Supply is added - Weight Spec is changed(Typ.200/Max.210 → Typ.199/Max.209) - Color Chromaticity is added - ROUTCLK Frequency Typ. Value is added - Packing Method is updated - T4 Timing is deleted - Information regarding EDID is deleted - Label in drawing is updated - Color Gamut is updated - Color Chromaticity in Appendix(EDID) is updated - 'Storage' Contents of General Precaution is updated
Aug. 24. 2011	A00	All	- LTN121XL01-N03 Approval Product Specification is issued.
Aug. 25. 2011	A01	11 16 20	- Max Power Pattern is added - Main Clock is added - Frame Freq. and One Line Scanning Time are added

GENERAL DESCRIPTION

DESCRIPTION

LTN121XL01 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight system. The resolution of a 12.1" contains 1024 x 768 pixels and can display up to 262,144 colors. 6 O'clock direction is the Optimum viewing angle.

FEATURES

- Thin and light weight
- High contrast ratio, high aperture structure
- 1024 x 768 pixels resolution (4:3)
- Fast Response Time
- Low power consumption
- LED BLU Structure
- DE (Data enable) only mode
- 3.3V LVDS Interface
- Pb-free product
- RoHS comply product
- Flicker should be optimized with 2 by 1 half gray green pattern before shipping MP.

APPLICATIONS

- Notebook PC
- If the usage of this product is not for PC application, but for others, please contact SEC

GENERAL INFORMATION

Item	Specification	Unit	Note
Display area	245.76(H) x 184.32mm(V) (12.1" diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	262,144		
Number of pixel	1024 x 768	pixel	4 : 3
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.240 (H) x 0.240 (V) (TYP.)	mm	
Display Mode	Normally Black, PLS Mode		
Surface treatment	Haze 25, Hardness 3H		Anti-Glare

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Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	256.8	257.3	257.8	mm	
	Vertical (V)	198.6	199.1	199.6	mm	
	Depth (D)	-	-	4.75	mm	(1)
Weight		-	199	209	g	

Note (1) Measurement condition of outline dimension
. Equipment : Vernier Calipers
. Push Force : 750g ·f (minimum)

1. ABSOLUTE MAXIMUM RATINGS

1.1 ENVIRONMENTAL ABSOLUTE RATINGS

Item	Symbol	Min.	Max.	Unit	Note
Storage temperate	T_{STG}	-20	60	°C	(1)
Operating temperate (Temperature of glass surface)	T_{OPR}	0	45	°C	(1)
Shock (non-operating)	Snop	-	210	G	(2),(5)
			50		(3),(5)
Vibration (non-operating)	Vnop	-	2.41	G	(4),(5)
Altitude (operation)	-	-	10,000	feet	
Altitude (storage)	-	-	40,000	feet	

Note (1) Temperature and relative humidity range are shown in the figure below.
95 % RH Max. (40 °C > Ta)
Maximum wet - bulb temperature at 39 °C or less. (Ta ≥ 40 °C) No condensation.
(2) 2ms, half sine wave, one time for ±X,±Y,±Z.
(3) 11ms, Trapezoidal wave, one time for ±X,±Y,±Z.
(4) 5~500 Hz, Random vibration, 30 min for X,Y,Z.
(5) At testing Vibration and Shock, the fixture in holding the Module to be tested have to be hard and rigid enough so that the Module would not be twisted or bent by the fixture.

Relative Humidity (%RH)
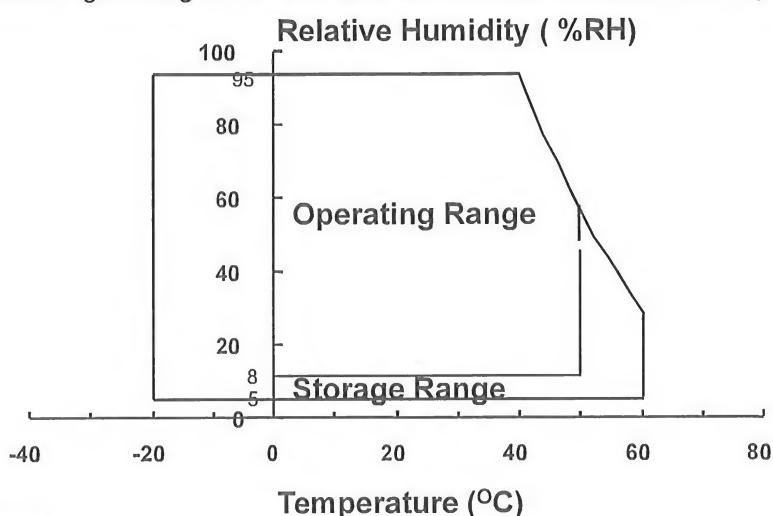
1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

V_{DD} =3.3V, V_{SS} = GND = 0V

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	$V_{DD} - 0.3$	$V_{DD} + 0.3$	V	(1)
Logic Input Voltage	V_{DD}	$V_{DD} - 0.3$	$V_{DD} + 0.3$	V	(1)

Note (1) Within Ta (25 ± 2 °C)

2. OPTICAL CHARACTERISTICS

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (5).
Measuring equipment : TOPCON SR-3

* Ta = 25 ± 2 ℃, V$_{DD}$=3.3V,   fv= 60Hz, fDCLK = **96.1** MHz, PWM duty = 100%

Item		Symbol	Condition	Min.	Typ.	Max	Unit	Note
Contrast Ratio		CR	1center point	500	700	-	-	(1), (2), (5)
Response Time at Ta (Rising + Falling)		T$_R$+T$_F$		-	30	45	msec	(1), (3)
Average Luminance of White		Y$_{L,AVE}$	1center point	240	300	-	cd/m^2	PWM duty = 100% (4)
Color Chromaticity (CIE 1931)	Red	R$_X$	Normal Viewing Angle ϕ = 0 θ = 0	0.560	0.590	0.620	-	(1), (5) SR-3
		R$_Y$		0.330	0.360	0.390		
	Green	G$_X$		0.300	0.338	0.368		
		G$_Y$		0.525	0.555	0.585		
	Blue	B$_X$		0.124	0.154	0.184		
		B$_Y$		0.090	0.120	0.150		
	White	W$_X$		0.283	0.313	0.343		
		W$_Y$		0.299	0.329	0.359		
Viewing Angle	Hor.	θ_L	CR ≥ 10	-	80	-	Degrees	(1), (5)
		θ_R		-	80	-		
	Ver.	ϕ_H		-	80	-		
		ϕ_L		-	80	-		
Color Gamut				-	46.5	-	%	
13 Points White Variation		δ_L		-	-	1.7	-	(6)

Note 1) Definition of Viewing Angle : Viewing angle range(10 ≤ C/R)

Normal Line
$\phi = 0°, \theta = 0°$

θ_L

θ_R

ϕ_I ϕ_H

$\theta_L = 90°$ X

12 O'clock
direction
$\phi_H = 90°$

y

6 O'clock   y'
direction
$\phi_L = 90°$

x'

$\theta_R = 90°$
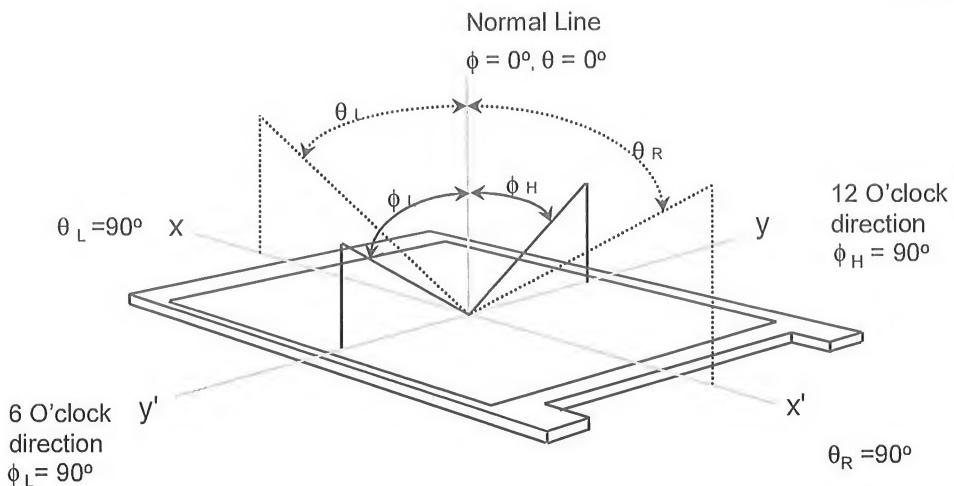
Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin)
at 5 points(4, 5, 7, 9, 10)

$$CR = \frac{CR(4) + CR(5) + CR(7) + CR(9) + CR(10)}{5}$$

Points   : ④ ,   ⑤ ,   ⑦ ,   ⑨ ,   ⑩   at the figure of Note (6).

Note 3) Definition of Response time :

Display data   ⟩White(TFT OFF)   Black(TFT ON)   White(TFT OFF) ⟩

T_R T_F

Optical
Response

100%
90%

10%
0%

Time
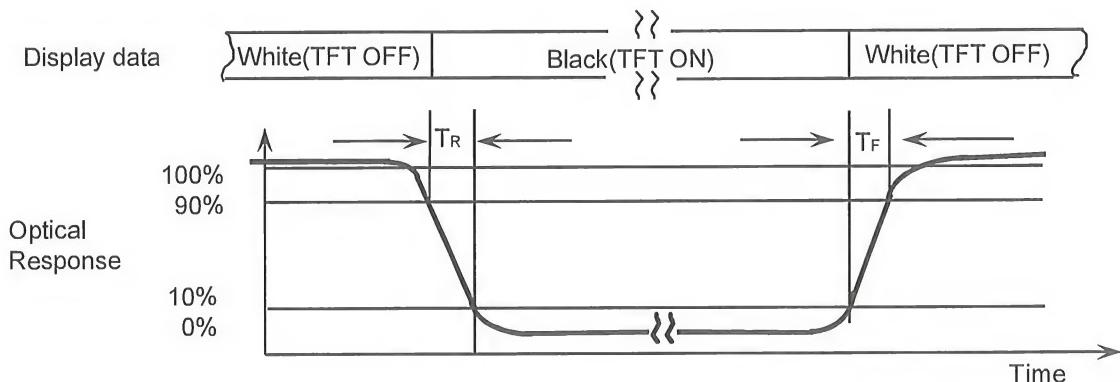
Note 4) Definition of Average Luminance of White : measure the luminance of white at 1 point.

. Center 1point of White ($Y_{L,AVE}$)

$Y_{,CENTER} = Y_{L7}$

(256)   (512)   (768)

VIEW AREA

(192)

⑦   (384)

(576)
(lines)
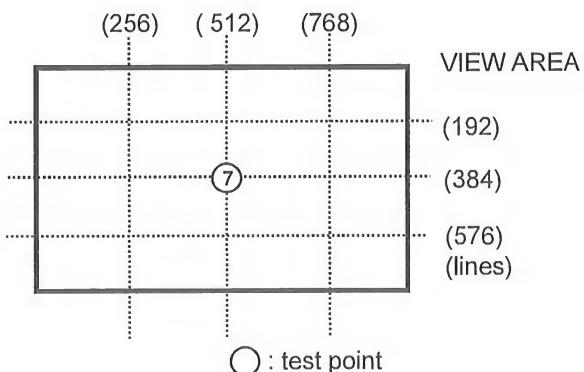
◯ : test point

Note 5) After stabilizing and leaVBLg the panel alone at a given temperature for 30 min , the measurement
should be executed. Measurement should be executed in a stable, windless,and dark room.
30 min after lighting the backlight. This should be measured in the center of screen.
LED current : 22.0 mA
Environment condition : Ta = 25 ± 2 °C

Photo-detector
(TOPCON SR-3)

Field = 2°

50 cm

TFT-LCD module

LCD panel

Center of the screen
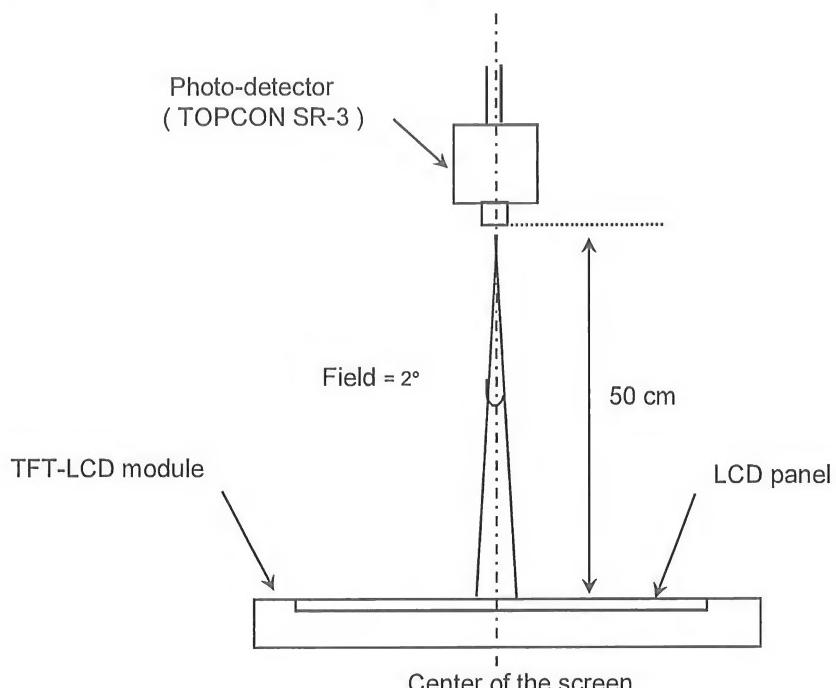
[Optical characteristics measurement setup]

Note 6) Definition of 13 points white variation (δ L), [① ~ ⑬]

$$\delta_L \ = \ \frac{\text{Maximum luminance of 13 points}}{\text{Minimum luminance of 13 points}}$$

10mm
10mm   256   512   768

10mm

⑬   ⑫   ⑪

⑩   ⑨   192

⑧   ⑦   ⑥   384   ○   : test point

⑤   ④   576
(lines)

③   ②   ①

10mm
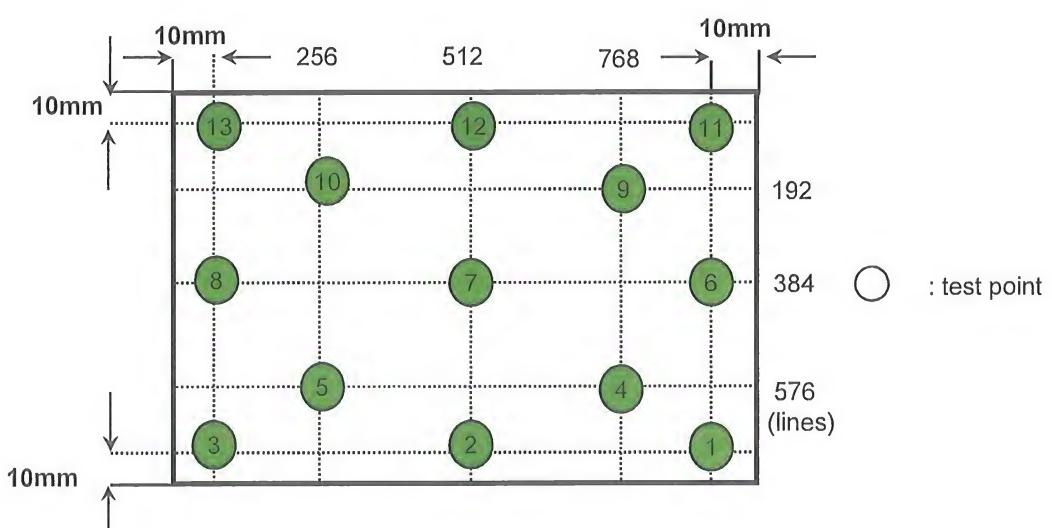
3. ELECTRICAL CHARACTERISTICS

Approval

3.1 TFT LCD MODULE

Ta= 25 ± 2°C

Item			Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply			V_{DD}	3.0	3.3	3.6	V	
Differential Input Voltage for LVDS Receiver Threshold		High	V_{IH}	-	-	+100	mV	V_{CM} = +1.2V
		Low	V_{IL}	-100	-	-	mV	
Vsync Frequency (fv)	60Hz	Hsync Freq	f_H	-	47.4	-	KHz	
		Main Freq	f_{DCLK}	64.1	71.29	80.3	MHz	
	40Hz	Hsync Freq	f_H	-	31.6	-	KHz	Guarantee only for electrical operation. No FOS quality guarantee.
		Main Freq	f_{DCLK}	-	47.5	-	MHz	
Rush Current			I_{RUSH}	-	-	1.5	A	(4)
Current of Power Supply		White	I_{DD}	-	230	-	mA	(2),(3)*a
		Mosaic		-	230	-	mA	(2),(3)*b
		1 Dot Ver		-	220	-	mA	(2),(3)*c
		Black			180			(2),(3)*d
		Max.		-	280	300	mA	(2),(3)*e

Note (1) Display data pins and timing signal pins should be connected.(GND = 0V)

(2) fv = 60Hz, f_{DCLK} = 71.29MHZ, V_{DD} = 3.3V , DC Current.

(3) Power dissipation pattern75

*a) White Pattern   *b) Mosaic Pattern

VIEW AREA

Display Brightest Gray Level →
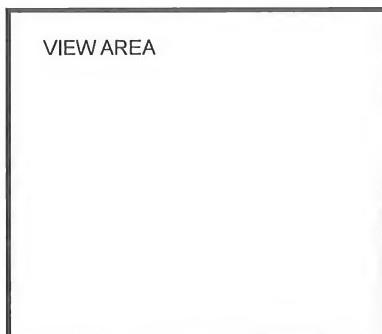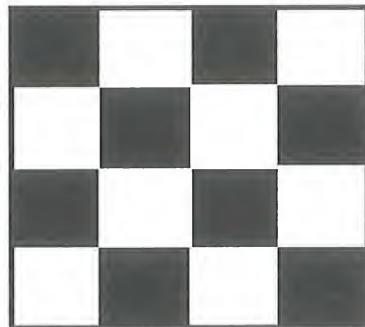
Display Darkest Gray Level →

*c) 1dot Vertical stripe pattern
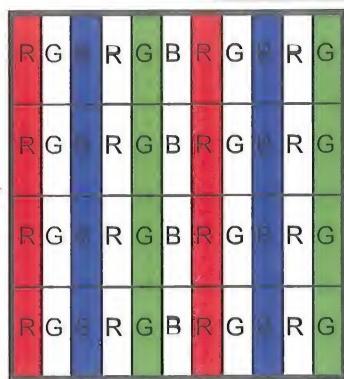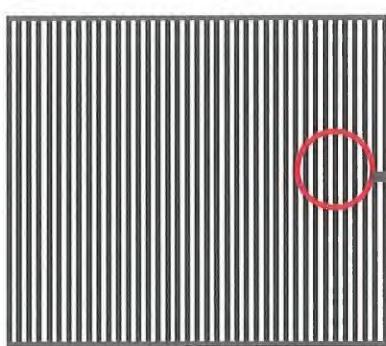
*d) Black
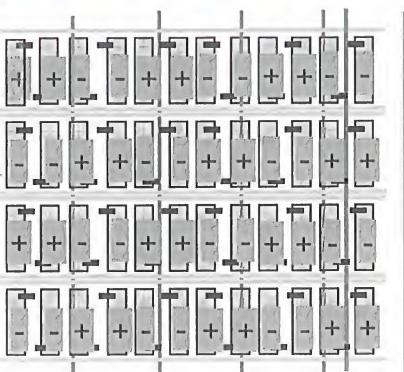
*e) Max pattern : 1 Dot
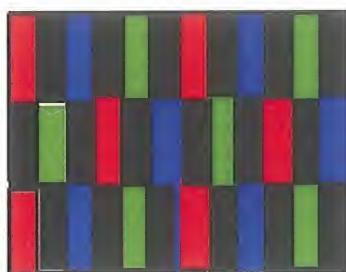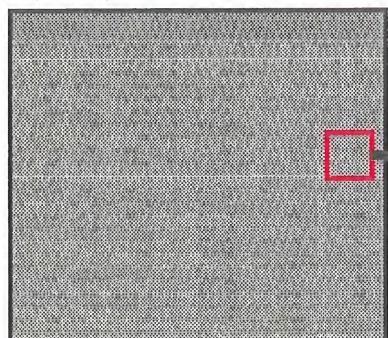
4) Rush current measurement condition

3.3V

M1
2SK1059

V_{DD} (LCD INPUT)

FUSE

R1
47K

C1
1uF

CONTROL SIGNAL
(HIGH to LOW)

R2
1K

M2
2SK1399

V_{DD} rising time is 470us

12V

R3
47K

C2
10000pF

C3
1uF

GND

0.9V_{DD}

0.1V_{DD}

3.3V

470us

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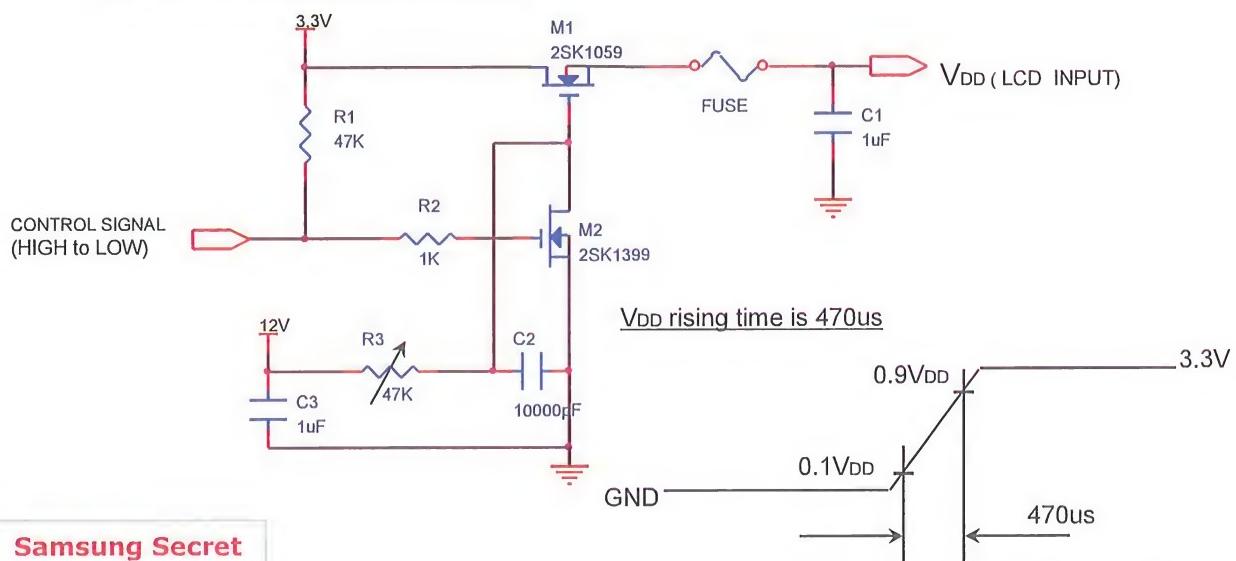
3.2 BACK-LIGHT UNIT

Ta= 25 ± 2 °C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Life Time	Hr	10,000	-	-	Hr	(1)

Note (1) Life time (Hr) of LEDs can be defined as the time in which it continues to operate under the
condition Ta= 25 ± 2 °C and PWM duty = 100% until one of the following event occurs.
- When the brightness becomes 50% or lower than the original.

3.3 LED Driver

- LED Driver Manufacturer : Richtek (RT8510)

Ta= 25 ± 2 °C

| Item	Symbol	Min.	Typ.	Max.	Unit	Note
Input Voltage	V_{BL}	7	12	21	V	
V_{LED} on level voltage	V_{LED_on}	7	-	21	V	
V_{LED} off level voltage	V_{LED_off}	0	-	2	V	
Input Current	I	-	(250)	(270)	mA	
Input Power	Pin	-	(3.00)	(3.24)	W	Pin = VBL x I
PWM duty ratio	-	1	-	100	%	(1)
PWM Frequency	F_{PWM}	0.12	-	30	KHz	(2)
PWM Impedance	Z_{PWM}	2.4	-	-	Mohm	
PWM high level vol.	V_{PWM_H}	2.0	-	5.0	V	
PWM low level vol.	V_{PWM_L}	0	-	0.5	V	
LED_EN Impedance	Z_{PWM}	50	-	-	Mohm	
LED_EN high vol.	$V_{LED\_EN\_H}$	2.0	-	5.0	V	
LED_EN low vol.	$V_{LED\_EN\_L}$	0	-	0.8	V	
LED rush current	$I_{LED\ RUSH}$	-	-	1.5	A	

Note - (1) Duty 1% for the frequency range from 120Hz to 1kHz
(2) PWM can be guaranteed under the same condition as operation temperate T_{OPR} 0 ~ 50 ℃.

4. BLOCK DIAGRAM

4.1 TFT LCD Module

- → Video Signal
- → Control Signal
- → VCOM
- → Gamma
- → DVDD
- → AVDD
- → Von/Voff
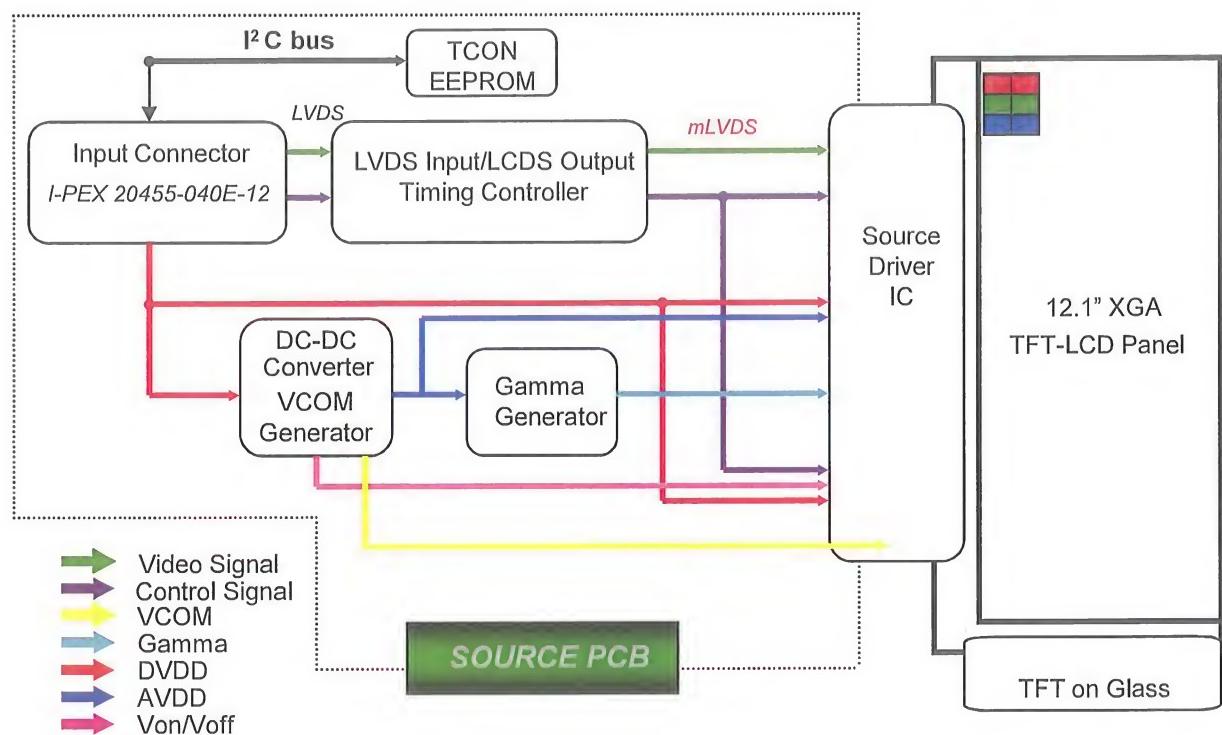
4.2 LED connection and placement

9 LEDs x 4 channels = Total 36 LEDs

LED Wiring

LED 36, Channel 4-9

LED 5, Channel 1-2
LED 4, Channel 4-1
LED 3, Channel 3-1
LED 2, Channel 2-1
LED 1, Channel 1-1
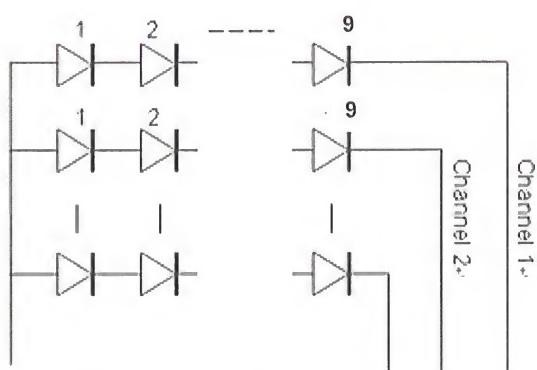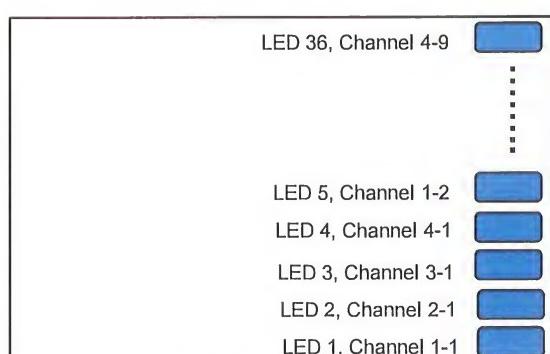
LED Placement

5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power   LVDS, Connector : I-PEX 20455-040E-02S
Mating Connector: I-PEX 20454-040T-01 or 02

Pin	Symbol	Function
1	NC	No Connection
2	VCC	Power Supply, 3.3V (typical)
3	VCC	Power Supply, 3.3V (typical)
4	NC	No Connection
5	NC	No Connection
6	NC	No Connection
7	NC	No Connection
8	RXin0-	- LVDS differential data (R0-R5, G0)
9	RXin0+	+ LVDS differential data (R0-R5, G0)
10	GND	Ground
11	RXin1-	- LVDS differential data (G1-G5, B0-B1)
12	RXn1+	+ LVDS differential data (G1-G5, B0-B1)
13	GND	Ground
14	RXin2-	- LVDS differential data (B2-B5,HS,VS, DE)
15	RXn2+	+ LVDS differential data (B2-B5,HS,VS, DE)
16	GND	Ground
17	ClkIN-	- LVDS differential clock input
18	ClkIN+	+ LVDS differential clock input
19	GND	Ground
20~21	NC	No Connection
22	GND	Ground
23~24	NC	No Connection
25	GND	Ground
26~27	NC	No Connection
28	GND	Ground
29~30	NC	No Connection
31~33	GND	LED Ground
34	NC	No Connection
35	PWM	PWM for luminance control
36	LED_EN	BL On/Off (On: 2.0~5.0V, Off: 0~0.8V)
37	NC	APS_EN
38~40	V_{BL}(7~21)	*LED Power Supply 7V-21V

5.2 LVDS Interface : Transmitter DS90CF363 or Compatible

Pin No.	Name	RGB Signal	Pin No.	Name	RGB Signal
51	TxIN0	R0	14	TxIN14	G5
52	TxIN1	R1	15	TxIN15	B0
54	TxIN2	R2	19	TxIN18	B1
55	TxIN3	R3	20	TxIN19	B2
56	TxIN4	R4	22	TxIN20	B3
3	TxIN6	R5	23	TxIN21	B4
4	TxIN7	G0	24	TxIN22	B5
6	TxIN8	G1	27	TxIN24	Hsync
7	TxIN9	G2	28	TxIN25	Vsync
11	TxIN12	G3	30	TxIN26	DE
12	TxIN13	G4	31	TxCLKIN	Clock

LVDS INTERFACE
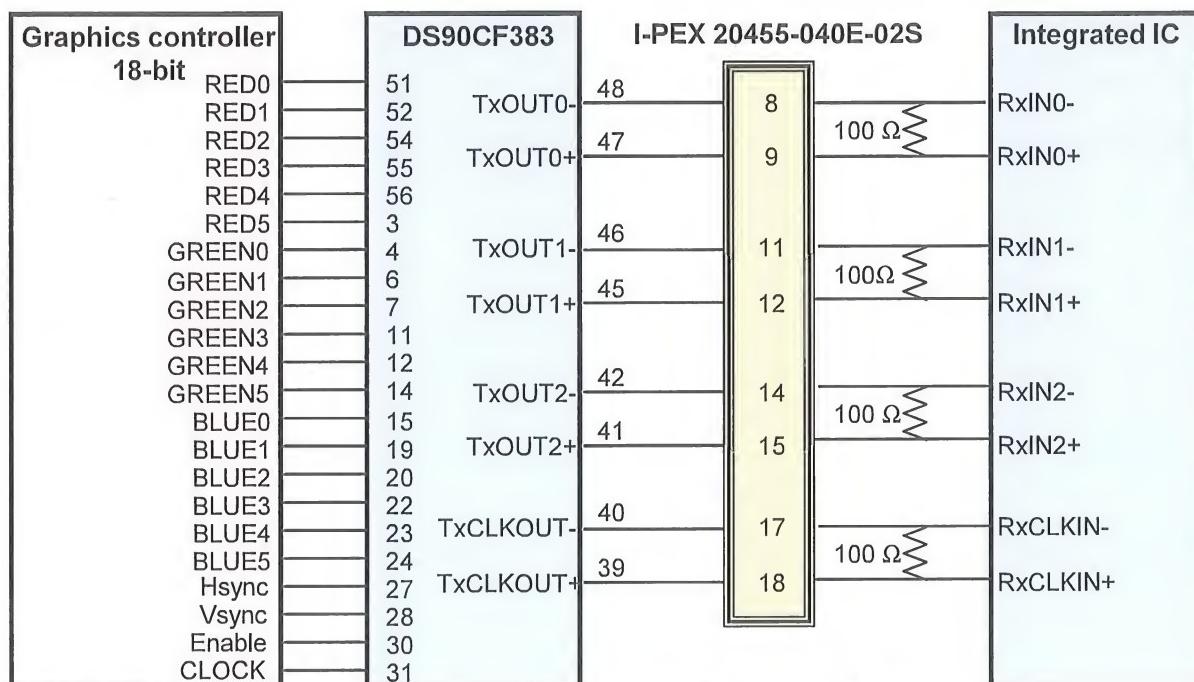
Note : The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

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5.3 LVDS characteristics

LVDS DC Specifications

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Differential input high threshold voltage	|VTH|	Vcm = 1.2V	100			mV
Differential input low threshold voltage	|VTL|		100			mV
Differential input voltage	|Vid|		100		600	mV
Common mode voltage	Vcm	|Vid| = 100mV, AVDD33I = 3.3V	0.4	1.2	2.9	V

LVDS AC Specifications

Characteristics	Symbol	Min	Typ	Max	Unit	Remarks
ROUTCLK frequency	fRCP		71.29		MHz	–
TTL data set-up to ROUTCLK	tRS	0.3/fRCP			ns	
TTL data hold from ROUTCLK	tRH	0.3/fRCP			ns	
Skew (Strobe) right margin	TRSRM			500	ps	
Skew (Strobe) left margin	TRSLM			500	ps	
LVDS clock to clock skew margin (Even to odd)	Tskew_eo	-1/7		+1/7	Tclk	–
Unit delay width in skew control block	Δ		100		ps	@NN,55°C,2.5/1.2V

Characteristics	Symbol	Min	Typ	Max	Unit	Remarks
Modulation Rate	Fmr	-3		3	%	@ MAINCLK = 71.29MHz
Modulation Frequency	Fmr	30		300	Khz	
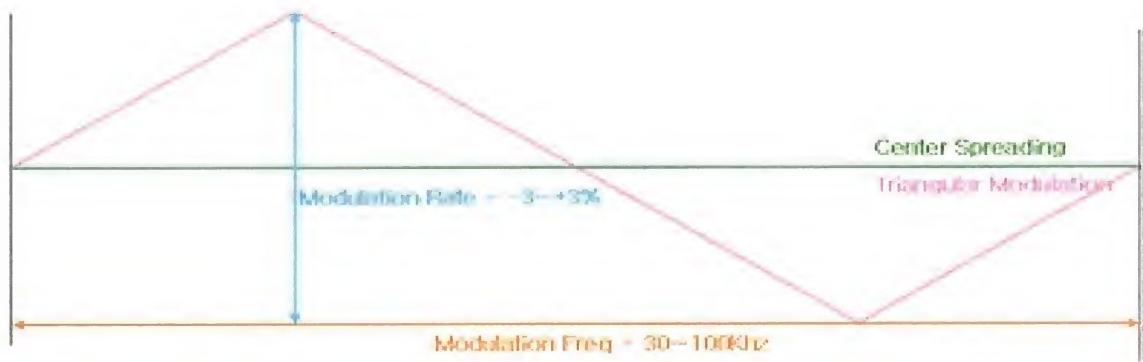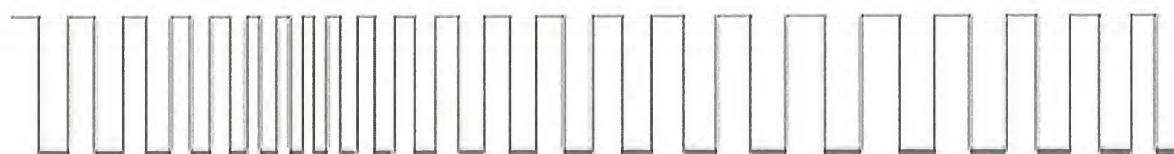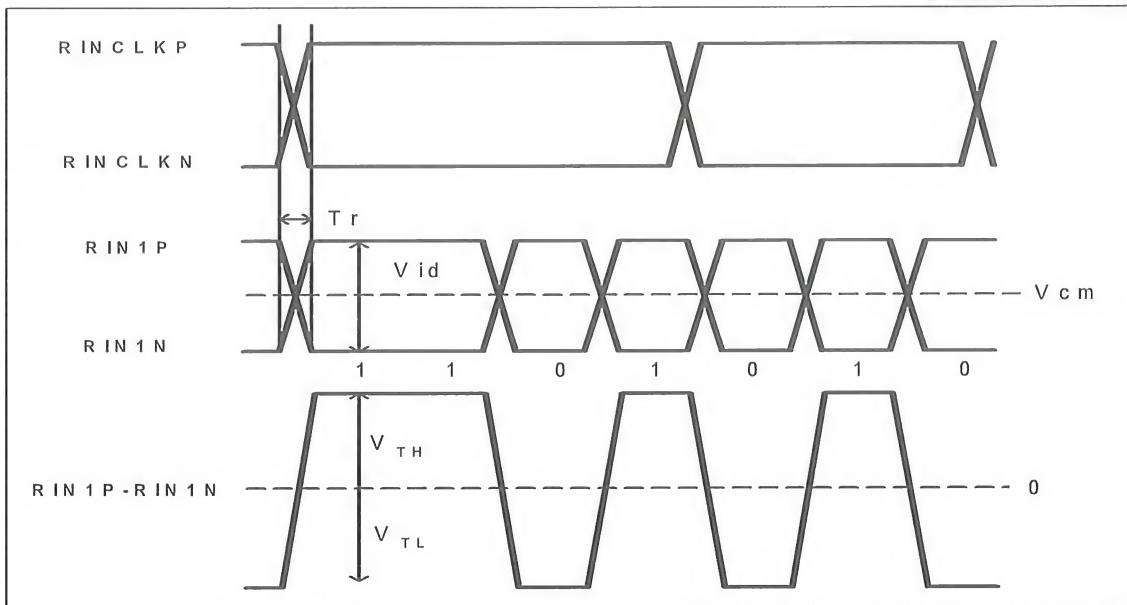
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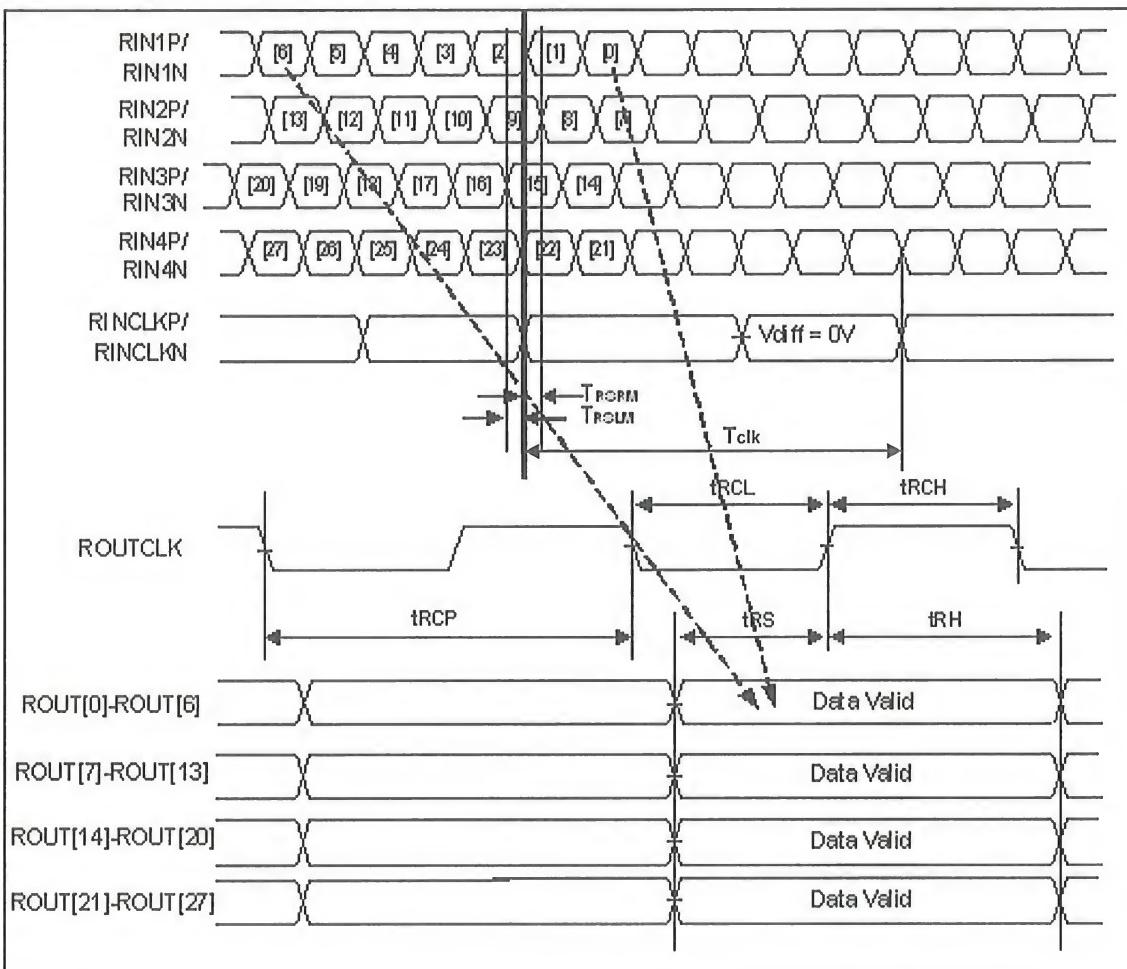
< Definition of LVDS AC characteristics >